Agency for Healthcare Research and Quality
Advancing Excellence in Health Care

NATIONAL QUALITY MEASURES CLEARINGHOUSE

General

Title

Diagnostic imaging: percentage of patients aged 14 years and younger with clinically suspected appendicitis who undergo CT, MRI, or ultrasound of the abdomen or pelvis for whom ultrasound was used as the initial imaging evaluation of the appendix.

Source(s)

American College of Radiology (ACR), American Medical Association-convened Physician Consortium for Performance ImprovementÂ® (PCPIÂ®), National Committee for Quality Assurance (NCQA). Diagnostic imaging performance measurement set. Reston (VA): American College of Radiology (ACR); 2015 Feb. 58 p. [89 references]

Measure Domain

Primary Measure Domain

Clinical Quality Measures: Process

Secondary Measure Domain

Does not apply to this measure

Brief Abstract

Description

This measure is used to assess the percentage of patients aged 14 years and younger with clinically suspected appendicitis who undergo computed tomography (CT), magnetic resonance imaging (MRI), or ultrasound of the abdomen or pelvis for whom ultrasound was used as the initial imaging evaluation of the appendix

Rationale

In recent years there has been growing concern about excess radiation exposure in the pediatric population. Radiation exposure is especially significant among pediatric patients due to various reasons including increased sensitivity and longer life expectancy (Brenner, 2002). Despite having a lower sensitivity than computed tomography (CT), ultrasound (US) has been shown to have high diagnostic

accuracy for patients presenting with symptoms of acute appendicitis (Hernandez et al., 2005). The use of routine ultrasound with selective CT has been demonstrated to be an effective approach for accurately diagnosing appendicitis while minimizing costs and exposure to ionizing radiation (Toorenvliet et al., 2010; Ramarajan et al., 2009; Le et al., 2013; Thirumoorthi et al., 2012; Krishnamoorthi et al., 2011).

The following evidence statements are quoted verbatim from the referenced clinical guidelines and other references:

Although CT is more accurate, US is nearly as good in experienced hands, and given the lack of ionizing radiation, is the preferred examination in children, particularly if equivocal results are followed up by CT. Thus the CT – after US – approach appears to have excellent accuracy, with reported sensitivity and specificity of 94%. A single retrospective study showed that in intermediate-to-high pretest probability children, US followed by CT is most cost-effective, whereas, in low pretest probability patients, US alone is the most effective and least costly strategy (Smith et al., 2013).

In children, US is the preferred initial examination, as it is nearly as accurate as CT for diagnosis of appendicitis without exposure to ionizing radiation (Smith et al., 2013).

In children, use ultrasound to confirm acute appendicitis but not to definitively exclude acute appendicitis (Howell et al., 2010).

In children, use an abdominal and pelvic CT to confirm or exclude acute appendicitis (Howell et al., 2010).

Evidence for Rationale

American College of Radiology (ACR), American Medical Association-convened Physician Consortium for Performance ImprovementÂ® (PCPIÂ®), National Committee for Quality Assurance (NCQA). Diagnostic imaging performance measurement set. Reston (VA): American College of Radiology (ACR); 2015 Feb. 58 p. [89 references]

Brenner DJ. Estimating cancer risks from pediatric CT: going from the qualitative to the quantitative. Pediatr Radiol. 2002 Apr;32(4):228-1; discussion 242-4. PubMed

Hernandez JA, Swischuk LE, Angel CA, Chung D, Chandler R, Lee S. Imaging of acute appendicitis: US as the primary imaging modality. Pediatr Radiol. 2005 Apr;35(4):392-5. PubMed

Howell JM, Eddy OL, Lukens TW, Thiessen ME, Weingart SD, Decker WW, American College of Emergency Physicians. Clinical policy: critical issues in the evaluation and management of emergency department patients with suspected appendicitis. Ann Emerg Med. 2010 Jan;55(1):71-116. [71 references] PubMed

Krishnamoorthi R, Ramarajan N, Wang NE, Newman B, Rubesova E, Mueller CM, Barth RA. Effectiveness of a staged US and CT protocol for the diagnosis of pediatric appendicitis: reducing radiation exposure in the age of ALARA. Radiology. 2011 Apr;259(1):231-9. PubMed

Le J, Kurian J, Cohen HW, Weinberg G, Scheinfeld MH. Do clinical outcomes suffer during transition to an ultrasound-first paradigm for the evaluation of acute appendicitis in children?. AJR Am J Roentgenol. 2013 Dec;201(6):1348-52. PubMed

Ramarajan N, Krishnamoorthi R, Barth R, Ghanouni P, Mueller C, Dannenburg B, Wang NE. An interdisciplinary initiative to reduce radiation exposure: evaluation of appendicitis in a pediatric emergency department with clinical assessment supported by a staged ultrasound and computed tomography pathway. Acad Emerg Med. 2009 Nov;16(11):1258-65. PubMed

Smith MP, Katz DS, Rosen MP, Lalani T, Carucci LR, Cash BD, Kim DH, Piorkowski RJ, Small WC,

Spottswood SE, Tulchinsky M, Yaghmai V, Yee J, Expert Panel on Gastrointestinal Imaging. ACR Appropriateness CriteriaÂ® right lower quadrant pain--suspected appendicitis. Reston (VA): American College of Radiology (ACR); 2013. 10 p. [74 references]

Thirumoorthi AS, Fefferman NR, Ginsburg HB, Kuenzler KA, Tomita SS. Managing radiation exposure in children--reexamining the role of ultrasound in the diagnosis of appendicitis. J Pediatr Surg. 2012 Dec;47(12):2268-72. PubMed

Toorenvliet BR, Wiersma F, Bakker RF, Merkus JW, Breslau PJ, Hamming JF. Routine ultrasound and limited computed tomography for the diagnosis of acute appendicitis. World J Surg. 2010 Oct;34(10):2278-85. PubMed

Primary Health Components

Clinically suspected appendicitis; computed tomography (CT); magnetic resonance imaging (MRI); abdominal ultrasound; pelvic ultrasound

Denominator Description

All patients aged 14 years and younger with clinically suspected appendicitis who undergo computed tomography (CT) or magnetic resonance imaging (MRI) or ultrasound of the abdomen or pelvis (see the related "Denominator Inclusions/Exclusions" field)

Numerator Description

Patients for whom ultrasound was used as the initial imaging evaluation of the appendix

Evidence Supporting the Measure

Type of Evidence Supporting the Criterion of Quality for the Measure

A clinical practice guideline or other peer-reviewed synthesis of the clinical research evidence

A formal consensus procedure, involving experts in relevant clinical, methodological, public health and organizational sciences

One or more research studies published in a National Library of Medicine (NLM) indexed, peer-reviewed journal

Additional Information Supporting Need for the Measure

Importance of Topic
As imaging technology continues to advance, the United States healthcare system has seen an increase in both the type and frequency of imaging studies being performed. The increase in utilization of imaging studies is accompanied by a corresponding increase in cost and exposure to radiation for both patients and healthcare professionals.

> From 1980 to 2006, the number of radiologic procedures performed in the United States showed a ten-fold increase while the annual per-capita effective dose from radiologic and nuclear medicine procedures increased by 600% (Mettler et al., 2009).
> From 1996 to 2010, the number of computerized tomographic (CT) examinations tripled, while the number of ultrasounds nearly doubled (Smith-Bindman et al., 2012).

From 1996 to 2010, advanced diagnostic imaging (i.e., CT, magnetic resonance imaging [MRI], nuclear medicine, and ultrasound) accounted for approximately 35% of all imaging studies (Smith-Bindman et al., 2012).
From 1980 to 2006, the proportion of radiation exposure that is attributable to medical sources increased from 17% to 53% (Mettler et al., 2009).
In 2006, while CT scans only accounted for approximately 17% of all radiologic procedures performed in the United States, they accounted for over 65% of the total effective radiation dose from radiologic procedures (Mettler et al., 2009).
In 2006, the estimated per-capita effective radiation dose for radiologic procedures in the United States was nearly 20% higher than the average for other well-developed countries (Mettler et al., 2009).

Diagnostic imaging was prioritized as a topic area for measure development due to a high level of utilization, rising costs, and the need for measures to help promote appropriate use of imaging and improve outcomes.

Opportunity for Improvement
CT use among children presenting with abdominal pain has increased significantly over time (Fahimi et al., 2012). Recent evidence has shown that imaging practices for pediatric appendicitis vary by clinical setting and physician specialty (Saito et al., 2013; Grim, 2014). For example, one study by Saito et al. (2013) found that children's hospitals were more likely to use ultrasound as the initial imaging study while community hospitals were more likely to use CT.

Evidence for Additional Information Supporting Need for the Measure

American College of Radiology (ACR), American Medical Association-convened Physician Consortium for Performance ImprovementÂ® (PCPIÂ®), National Committee for Quality Assurance (NCQA). Diagnostic imaging performance measurement set. Reston (VA): American College of Radiology (ACR); 2015 Feb. 58 p. [89 references]

Fahimi J, Herring A, Harries A, Gonzales R, Alter H. Computed tomography use among children presenting to emergency departments with abdominal pain. Pediatrics. 2012 Nov;130(5):e1069-75. PubMed

Grim PF. Emergency medicine physicians' and pediatricians' use of computed tomography in the evaluation of pediatric patients with abdominal pain without trauma in a community hospital. Clin Pediatr. 2014 May;53(5):486-9. PubMed

Mettler FA, Bhargavan M, Faulkner K, Gilley DB, Gray JE, Ibbott GS, Lipoti JA, Mahesh M, McCrohan JL, Stabin MG, Thomadsen BR, Yoshizumi TT. Radiologic and nuclear medicine studies in the United States and worldwide: frequency, radiation dose, and comparison with other radiation sources--1950-2007. Radiology. 2009 Nov;253(2):520-31. PubMed

Saito JM, Yan Y, Evashwick TW, Warner BW, Tarr PI. Use and accuracy of diagnostic imaging by hospital type in pediatric appendicitis. Pediatrics. 2013 Jan;131(1):e37-44. PubMed

Smith-Bindman R, Miglioretti DL, Johnson E, Lee C, Feigelson HS, Flynn M, Greenlee RT, Kruger RL, Hornbrook MC, Roblin D, Solberg LI, Vanneman N, Weinmann S, Williams AE. Use of diagnostic imaging studies and associated radiation exposure for patients enrolled in large integrated health care systems, 1996-2010. JAMA. 2012 Jun 13;307(22):2400-9. PubMed

Extent of Measure Testing

Some of the measures in this set are being made available without any prior testing. The Physician

Consortium for Performance Improvement (PCPI) recognizes the importance of testing all of its measures and encourages testing of the diagnostic imaging measurement set for feasibility and reliability by organizations or individuals positioned to do so. The *Measure Testing Protocol for PCPI Measures* was approved by the PCPI in 2010 and is available on the PCPI Web site (see Position Papers at www.physicianconsortium.org); interested parties are encouraged to review this document and to contact PCPI staff. The PCPI will welcome any opportunity to promote the initial testing of these measures and to ensure that any results available from testing are used to refine the measures before implementation.

Evidence for Extent of Measure Testing

American College of Radiology (ACR), American Medical Association-convened Physician Consortium for Performance ImprovementÂ® (PCPIÂ®), National Committee for Quality Assurance (NCQA). Diagnostic imaging performance measurement set. Reston (VA): American College of Radiology (ACR); 2015 Feb. 58 p. [89 references]

State of Use of the Measure

State of Use

Current routine use

Current Use

not defined yet

Application of the Measure in its Current Use

Measurement Setting

Ambulatory/Office-based Care

Ambulatory Procedure/Imaging Center

Hospital Inpatient

Hospital Outpatient

Long-term Care Facilities - Other

Skilled Nursing Facilities/Nursing Homes

Professionals Involved in Delivery of Health Services

not defined yet

Least Aggregated Level of Services Delivery Addressed

Single Health Care Delivery or Public Health Organizations

Statement of Acceptable Minimum Sample Size

Does not apply to this measure

Target Population Age

Age less than or equal to 14 years

Target Population Gender

Either male or female

National Strategy for Quality Improvement in Health Care

National Quality Strategy Aim

Better Care

National Quality Strategy Priority

Making Care Safer
Prevention and Treatment of Leading Causes of Mortality

Institute of Medicine (IOM) National Health Care Quality Report Categories

IOM Care Need

Getting Better

IOM Domain

Effectiveness

Safety

Data Collection for the Measure

Case Finding Period

Unspecified

Denominator Sampling Frame

Patients associated with provider

Denominator (Index) Event or Characteristic

Clinical Condition

Diagnostic Evaluation

Patient/Individual (Consumer) Characteristic

Denominator Time Window

not defined yet

Denominator Inclusions/Exclusions

Inclusions
All patients aged 14 years and younger with clinically suspected appendicitis* who undergo computed tomography (CT) or magnetic resonance imaging (MRI) or ultrasound of the abdomen or pelvis

**Clinically Suspected Appendicitis*: For the purposes of this measure, clinically suspected appendicitis includes lower right quadrant pain.

Exclusions
Unspecified

Exceptions
Medical reason(s) for not using ultrasound as the initial imaging evaluation of the appendix (e.g., patient is obese, other medical reason[s])

Note:

> *Obesity*: For this measure, obesity must be included in the problem list within the patient's electronic health record (EHR) in order to be captured as a medical exception.
> Ultrasound is recommended as the initial imaging modality of choice for clinically suspected appendicitis. However, the medical reason exception should be used for scenarios where doing so would result in an unacceptable delay of care or would be otherwise inappropriate.

Exclusions/Exceptions

not defined yet

Numerator Inclusions/Exclusions

Inclusions
Patients for whom ultrasound was used as the initial imaging evaluation of the appendix

Exclusions
Unspecified

Numerator Search Strategy

Fixed time period or point in time

Data Source

Electronic health/medical record

Imaging data

Paper medical record

Registry data

Type of Health State

Does not apply to this measure

Instruments Used and/or Associated with the Measure

Unspecified

Computation of the Measure

Measure Specifies Disaggregation

Does not apply to this measure

Scoring

Rate/Proportion

Interpretation of Score

Desired value is a higher score

Allowance for Patient or Population Factors

not defined yet

Standard of Comparison

not defined yet

Identifying Information

Original Title

Measure #5: utilization of ultrasonography in children with clinically suspected appendicitis.

Measure Collection Name

Diagnostic Imaging Performance Measurement Set

Submitter

American College of Radiology - Medical Specialty Society

Developer

American College of Radiology - Medical Specialty Society

National Committee for Quality Assurance - Health Care Accreditation Organization

Physician Consortium for Performance ImprovementÂ® - Clinical Specialty Collaboration

Funding Source(s)

Unspecified

Composition of the Group that Developed the Measure

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Financial Disclosures/Other Potential Conflicts of Interest

None of the members of the Diagnostic Imaging Work Group had any disqualifying material interest under the Physician Consortium for Performance Improvement (PCPI) Conflict of Interest Policy.

Adaptation

This measure was not adapted from another source.

Date of Most Current Version in NQMC

2015 Feb

Measure Maintenance

This measure is reviewed and updated every 3 years.

Date of Next Anticipated Revision

2018

Measure Status

This is the current release of the measure.

Measure Availability

Source available from the American College of Radiology (ACR) Web site .

For more information, contact ACR at 1891 Preston White Drive, Reston, VA 20191; Phone: 703-648-8900; E-mail: info@acr.org; Web site: www.acr.org .

NQMC Status

This NQMC summary was completed by ECRI Institute on October 13, 2015. The information was verified by the measure developer on November 19, 2015.

Copyright Statement

This NQMC summary is based on the original measure, which is subject to the measure developer's copyright restrictions.

Production

Source(s)

American College of Radiology (ACR), American Medical Association-convened Physician Consortium for Performance ImprovementÂ® (PCPIÂ®), National Committee for Quality Assurance (NCQA). Diagnostic imaging performance measurement set. Reston (VA): American College of Radiology (ACR); 2015 Feb. 58 p. [89 references]

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